

We claim:

- 1 1. A closed-loop method for the manufacture of foamed polymeric material, comprising:
  - 2 (a) interleaving an article of raw polymeric material with a gas channeling means;
  - 3 (b) exposing the interleaved article at elevated pressure to a non-reacting gas
  - 4 which is soluble in the polymer for a time sufficient to achieve a desired concentration of
  - 5 gas within the polymer, thereby forming an exposed polymeric article which is at least
  - 6 partially gas-saturated;
  - 7 (c) decompressing the exposed polymeric article and separating the article from
  - 8 the gas channeling means;
  - 9 (d) foaming the exposed article at a temperature below the melt temperature of the
  - 10 polymeric material; and
  - 11 (e) trimming the foamed article to produce finished foamed polymeric material
  - 12 and scrap solid state process foamed polymer,
  - 13 wherein the raw polymeric material comprises 5% to 100% of any one of the
  - 14 group consisting of recycled pre-consumer polymer, recycled post-consumer polymer and
  - 15 scrap solid state process foamed polymer.
  
- 1 2. A closed-loop method for the manufacture of foamed polymeric objects, comprising:
  - 2 (a) interleaving an article of raw polymeric material with a gas channeling means;
  - 3 (b) exposing the interleaved article at elevated pressure to a non-reacting gas
  - 4 which is soluble in the polymer for a time sufficient to achieve a desired concentration of
  - 5 gas within the polymer, thereby forming an exposed polymeric article which is at least
  - 6 partially gas-saturated;
  - 7 (c) decompressing the exposed polymeric article and separating the article from
  - 8 the gas channeling means;
  - 9 (d) foaming the exposed article at a temperature below the melt temperature of the
  - 10 polymeric material; and
  - 11 (e) trimming and forming the foamed article to produce foamed polymeric objects
  - 12 and scrap solid state process foamed polymer,

13 wherein the raw polymeric material comprises 5% to 100% of any one of the group  
14 consisting of recycled pre-consumer polymer, recycled post-consumer polymer and scrap  
15 solid state process foamed polymer.

1 3. A closed-loop method for the manufacture of foamed semi-crystalline polymeric  
2 objects, comprising:

3 (a) interleaving an article of raw polymeric material with a gas channeling means;

4 (b) exposing the interleaved article at elevated pressure to a plasticizing gas for a  
5 time sufficient to achieve a desired concentration of gas, and to increase the level of  
6 crystallinity at the surfaces, thereby forming an exposed polymeric article which is at least  
7 partially gas-saturated and at least a portion of which has increased crystallinity;

8 (c) decompressing the exposed polymeric article and separating the article from  
9 the gas channeling means;

10 (d) foaming the exposed article at a temperature below the melt temperature of the  
11 polymeric material; and

12 (e) trimming and forming the foamed article to produce a foamed polymeric  
13 object and scrap solid state process foamed polymer,

14 wherein the raw polymeric material comprises 5% to 100% of any one of the group  
15 consisting of recycled pre-consumer polymer, recycled post-consumer polymer and scrap  
16 solid state process foamed polymer.

1 4. A method according to claim 1, claim 2, or claim 3, wherein the temperature at which  
2 the exposed article is foamed is equal to or above the glass transition temperature of the  
3 exposed article.

1 5. A method according to claim 1, claim 2, or claim 3, wherein the temperature at which  
2 the article is exposed to elevated pressure is sufficiently low and the pressure of non-  
3 reacting gas to which the article is exposed is sufficiently high that the temperature at  
4 which foaming starts is below the glass transition temperature of the unsaturated polymer.

1 6. A method according to claim 1, claim 2, or claim 3, wherein the temperature at which  
2 the article is exposed to elevated pressure is sufficiently low and the foaming temperature  
3 is at or above the glass transition temperature, to enhance the foaming of the polymer,  
4 thereby reducing the density of the resultant foam.

1 7. A method according to claim 1, claim 2, or claim 3, further comprising reprocessing  
2 substantially all of the scrap solid state process foamed polymer to make raw polymeric  
3 material for further closed-loop manufacture of foamed material.

1 8. A method according to claim 1, claim 2, or claim 3, further comprising inducing the  
2 formation of a skin of unfoamed polymer on the foamed article.

1 9. A method according to claim 2 or claim 3, further comprising applying additional heat  
2 to the object at a temperature below the melting temperature of the unsaturated polymer  
3 to raise the crystallinity level of the surface of the foamed object.

1 40. A method according to claim 2 or claim 3, further comprising applying additional  
2 heat to the object while it is still at least partially gas saturated to raise the crystallinity  
3 level of the surface of the foamed object.

1 11. A method according to claim 2 or claim 3, further comprising applying additional  
2 heat to the object to raise the crystallinity level of the surface of the foamed object to a  
3 level sufficient to increase the maximum operating or service temperature of the object.

1 11. A closed-loop method for the manufacture of foamed polymeric material,  
2 comprising:  
3 foaming raw polymeric material at a temperature below its melt temperature to produce  
4 solid state process foamed polymeric material, wherein the raw polymeric material

5 comprises up to 100% of any one of the group consisting of recycled pre-consumer  
6 polymer, recycled post-consumer polymer and scrap solid state process foamed polymer.